

# MARK TWAIN NATIONAL WILDLIFE REFUGE

## WATER MANAGEMENT PLAN

### II -- INTRODUCTION

#### A. GENERAL

Mark Twain National Wildlife Refuge lies in the heart of the Mississippi River Valley, and embraces the historical home of Tom Sawyer and Huckleberry Finn. Officially established in August of 1958 for the protection and preservation of the migratory waterfowl resource, the refuge is distributed along 250 miles of the Great River.

The entire refuge is located on either the Mississippi or Illinois River flood plains. Portions of the Refuge that are not protected by main stem levees; The Gardner, Batchtown and Calhoun Units, and the Big Timber and Turkey Island Public Hunting Areas, are subject to annual flooding and at times are completely inundated. The other units are protected by levees, but are affected by water tables through seep and surface runoff. Water Management is the most important factor affecting the success or failure of our refuge management programs. Therefore, the purpose of this plan is to provide broad guidelines for the proper management of our water resource and to outline future water developments.

#### B. OBJECTIVES

The specific purpose of the refuge water management program and/or developments is to assist in the accomplishment of the number one primary objective of the refuge; that is to provide migrating waterfowl with food, water and protection during the fall and spring months. The refuge water management program should be used to fulfill this objective by facilitating the production and utilization of waterfowl foods. Where possible it should be used to fulfill primary objective number two which is to improve and maintain existing habitat to perpetuate a good annual production of wood ducks. It can be beneficial to this objective by providing adequate water and cover for wood duck broods.

Whenever possible, without damage to the primary objectives, the water management program should also be used as a tool to accomplish the secondary objectives which are (1) to provide food, water, and protection to wintering waterfowl; (2) to maintain balanced populations of all resident wildlife species; (3) maintain portions of the refuge river bottom habitat in its natural virgin state; (4) to provide limited day-use recreation where and when such activities are compatible with primary management objectives of the refuge.

### C. DESCRIPTION OF REFUGE

Since our water management efforts are restricted to the refuge units or closed areas we will limit this plan to those areas. The public hunting areas are unprotected from the main river and are subject to the whims of nature and the navigation needs of the U. S. Corps of Engineers. Because each unit must be managed individually, we have listed each one separately showing existing facilities, the proposed program and recommendations for the future.

## II -- UNIT WATER MANAGEMENT

### A. LOUISA UNIT

#### 1. DESCRIPTION

The Louisa Unit of Mark Twain National Wildlife Refuge and the State managed Lake Odessa area lie within the old Louisa Drainage District. The area is bordered on the north by Michael Creek, on the east by the Mississippi River, on the south by the Iowa River and on the west by the Mississippi Bluffs. The area comprises some 6,390 acres which is divided into two areas: The Louisa Unit of 2,270 acres and a State managed public hunting area of 4,120 acres.

The Louisa Unit lies within what was once known as the Louisa County Levee District No. 15. Under reorganization in 1919 the levees were maintained by the Muscatine-Louisa County Drainage District No. 13. Since 1919 there has been a more or less constant effort to pump and farm the area. Prior to completion of Lock and Dam No. 17 at mile-age marker 437.1 approximately twenty-five per cent of the area was cultivated, but in general, crop production was poor. Seepage through

the levees and runoff from the bluff made pumping impractical.

Finally, control of water levels became too costly and all pumping operations ceased. Farming was reduced to a few minor areas in 1937 and continued that way until 1947. In 1947 the Iowa River overtopped the south levee, and during the process of repair by the U. S. Corps of Engineers, the State of Iowa placed an outlet structure on the levee to control the water within the levee district. From 1947 to 1951 the State of Iowa controlled water levels in an attempt to improve hunting and fishing. In 1951, the Mississippi River broke the main levee both above and below Lock and Dam No. 17, destroying the control structure at the south end and thereby destroying all control of the water within the area.

The U. S. Corps of Engineers repaired the levee, and the State immediately began work on new control structures. An inlet was placed at the northeast corner of the north closed area and the outlet on Burris Ditch, the dividing line between the old south closed area and the State managed public hunting area. The inlet and outlet structures each have three 4-foot pipes.

The U. S. Corps of Engineers Lock and Dam No. 17 is located about midway of the area. At normal summer river elevations there is a five foot drop between pools No. 17 and 18, and because the inlet is in pool No. 17 and the outlet is in pool No. 18 the water in the area can be manipulated to the extent of the difference in elevation between the pools.

Within this system of levees and control structures the refuge has constructed a diversion system for the Fox Pond Area or interior area. A stop-log diversion has been constructed in the State's inlet ditch and a diversion ditch dug from there to Prairie Pocket and thence to Fox Pond. In addition a stop-log structure has been constructed at the south end of Fox Pond and a twelve inch electric pump installed. This diversion system allows the refuge to control the interior water area from a low summer level of 23 surface acres to a high fall level of 336 surface acres.

## 2. MANIPULATION

TABLE OF WATER ACREAGES  
FOX POND AREA OR INTERIOR AREA

<u>Elevation</u>	<u>Area (Acres)</u>	<u>Capacity (Acre-Feet)</u>
536.0	336	624
535.0	224	344
533.5	77	119
533.0	52	87
532.0	38	42
531.0	23	12

Average Depth Assumed: .5 foot at 531.0.

PRAIRIE POCKET

<u>Elevation</u>	<u>Area (Acres)</u>	<u>Capacity (Acre-Feet)</u>
536.0	52	182
535.0	43	135
533.5	33	79
533.0	29	64
532.0	25	37

Average Depth Assumed: 1.5 feet at 532.0.

LAKE ODESSA (REFUGE)

<u>Elevation</u>	<u>Area (Acres)</u>	<u>Capacity (Acre-Feet)</u>
535.0	782	2,698
533.5	419	1,872
533.0	337	1,685

Average Depth Assumed: 5.0 feet at 533.0.

# TOTAL UNIT WATERS

<u>Elevation</u>	<u>Area (Acres)</u>	<u>Capacity (Acre-Feet)</u>
536.0	388 *	806 *
535.0	1,049	3,177
533.5	529	2,070
533.0	418	1,836
532.0	63 *	79 *
531.0	23 **	12 **

\* Fox Pond and Prairie Pocket Total

\*\* Fox Pond Total

Full normal pool above Dam No. 17 is 536.0. The U. S. Corps of Engineers use a gauge on the pool that reads 9.3 at full pool stage. The Bureau has a gauge in the Lake Odessa inlet ditch that also reads 9.3 feet at an elevation of 536.0 feet. The Fox Pond gauge located at the Fox Pond outlet reads 9.3 feet at an elevation of 536.0 feet.

Management of the water on the Louisa Unit is determined mainly by the water levels that exist on Lake Odessa. Because of this inter-relationship between the State and the Bureau water management programs, there has been a memorandum of agreement which has been executed between the Bureau and the State of Iowa which states that the Lake Odessa water level will be manipulated as follows:

1. That the water levels on Lake Odessa will be held at a summer level (gauge reading 6.8) or lower from the close of the fall waterfowl season to October 1, the following year.
2. After October 1, the water levels will be raised to gauge reading 7.8 and maintained at 7.8 until October 15.
3. After October 15, the Lake level will be raised to gauge reading 8.2 or higher until the close of the Iowa waterfowl hunting season.
4. After the close of the Iowa season, the water level will be reduced to the summer level of 6.8.
5. Levels within the Louisa Unit will be maintained at the 8.2 reading or higher until all waterfowl have departed, then levels will be reduced to the 6.8 reading.

6. It is understood that levels may be influenced by natural runoff and minor fluctuations may occur, but the agreed level will be regained as quickly as outside conditions will permit.
7. This agreement shall be in effect from the date of executing until December 31, 1965. This agreement may be extended, modified, or terminated by mutual agreement of the parties hereto.

The above agreement and the existing facilities in effect allow the refuge to increase the surface acreage of the unit from a summer level of 385 surface acres to a fall level of 1,170 surface acres, including 250 to 350 acres of moist soil crops, usually millet and buckwheat.

The usual procedure followed to achieve this success is as follows: Following the close of the waterfowl season the Bureau diversion structure on the inlet ditch is closed along with the State inlet from the river. A plug is placed in the Prairie Pocket outlet tube and Fox Pond allowed to seek the level of Lake Odessa which should be near the 6.8 level. Starting about April 1st, the pumping of Fox Pond into Lake Odessa is started. Under normal operating conditions it will take approximately three weeks, pumping 24 hours a day, to pump Fox Pond down to a level of 531.5. Thereafter it can be held at that level throughout the summer with intermittent pumping. This operation has been demonstrated with our present twelve inch pump for several years. This early drawdown facilitates farming of the low areas and allows for maximum production of moist soil plants.

Beginning in September, Fox Pond is allowed to raise to the 533.5 level through seepage and surface runoff. After October 1, Fox Pond will be allowed to fluctuate with Lake Odessa until the 535.0 level is reached. At this time Fox Pond will be raised to 536.0, the normal stage of the Mississippi River in Pool No. 17, or higher depending upon the river stage. This is done by inserting stop-logs into the diversion structure and diverting Mississippi River water into the refuge system.

Following the close of the waterfowl season the inlet pipes are closed and the stop-logs removed from the Fox Pond outlet structure. Fox Pond is allowed to seek the level of Lake Odessa which should be the summer level of 6.8.

This type of management allows the refuge to flood luxuriant growths of smartweed, wild millet, rice cut grass and Bidens sp. The manipulation of Lake Odessa alone allows the utilization of 1445 acres of

natural aquatics and flooded cropland. Further manipulation of the Fox Pond Area provides for an additional 313 surface acres of flooded aquatics and moist soil crops.

### 3. RECOMMENDATIONS

#### a. ANNUAL WATER PROGRAM

It is recommended that future annual water management programs follow substantially what we have outlined above. More specific recommendations can be made at the time the Refuge Manager submits his annual water program.

#### b. DEVELOPMENT

The objective of future development on the Louisa Unit is to have more effective control of the unit waters outside of the Fox Pond or interior area. This in substance means divorcing the refuge waters from the State controlled Lake Odessa. As outlined on the attached map (Exhibit 1) the development would be a two phase project. The first would include the construction of approximately three miles of dike around the south end of the unit. Included in this phase would be the installation of a 30,000 G.P.M. electric reversible water pump on the southwest corner. These facilities would allow the refuge to have maximum control of water levels on an additional 400 acres of waterfowl habitat, most of which would be adaptable to moist soil plants. It would in addition make the most important water areas independent of the State's water management program which will come under heavy recreational pressure to raise the summer level. It will also eliminate the need of the Fox Pond pump which should be replaced if its use is continued.

Phase two of the development calls for the construction of one-quarter mile of dike across the neck of Upper Lake Odessa blocking off the area known as Little Goose Pond. A 20,000 G.P.M. electric reversible pump would be installed on the dike. These facilities would give the refuge optimum control on an additional 350 acres, mainly timber. The portion that is now open water could be drawn down in the summer and allowed to be invaded by natural emergent growth.

The two development phases will give the unit optimum control of its entire water acreage excluding the Muscatine Slough. It will enable the refuge to drawdown and flood at will almost the entire area.

In lieu of this development it is extremely important that the State and Bureau water agreement be extended to continue our present program. It is considered a pillar of strength for Iowa to fall back on when recreational forces push for higher summer levels for boating and fishing.

B. KEITHSBURG UNIT

1. DESCRIPTION

The Keithsburg Unit of Mark Twain National Wildlife Refuge consists of 1,396 acres of bottomland located immediately north of the town of Keithsburg, Illinois. The unit is bordered on the west by the Mississippi River and lies entirely within Pool No. 18. It is bounded on the north by a levee which is only a short distance south of the Edwards River. The boundary on the east is a sand escarpment which rises abruptly above the flood plain, and the south boundary is the Minneapolis and St. Louis Railroad right-of-way.

The refuge is three miles long and averages three-quarters mile in width. The extremes in width vary from three-eighths mile to one mile.

This area was formerly a privately owned drainage district. The drainage district was formed in 1909, the area diked and cleared of timber and brush, and approximately 1,000 acres was put into cultivation. Farming was found to be an unprofitable venture due to the small acreage farmed in relation to the expense of dike maintenance and pumping. In 1929 the flood waters of the Mississippi River breached the levee and destroyed the pump house. A gravity system was then installed but this proved unequal to the task. The ground became waterlogged and started a gradual return to wetland shrubs.

In 1942 the War Department purchased the area in connection with the channelization project on the Mississippi River. Crop leases were entered into by the War Department for approximately 500 acres of still tillable land.

The levee was broken in numerous places during the floods of 1951 and 1952, putting six feet of water over the refuge. These breaks resulted in reducing the tillable acres to approximately 160 acres by 1959. Because the area would flood frequently, farming became very haphazard and as a result late cropping operation distracted from the usefulness of the area as a waterfowl area.



In an effort to achieve water control the Bureau rebuilt the Keithsburg Levee in 1960. At the same time, a water control structure, consisting of two 36 inch pipes with slide gates, was constructed on the southwest corner of the unit. These facilities protected the area from the fluctuations of the river but failed to provide the control desired. The pipes proved to be inadequate and did not allow the area to either drain or fill fast enough.

Two water gauges are located on the unit. A river gauge at the outlet structure with a O.O of 523.19 and a pool gauge at the same location with a O.O of 523.19.

There are two sources of water for this area, neither of which is dependable during the time of year desired. An internal supply is surface runoff of fall rains (6.82 inches in September and October) and the springs located along the bluffs on the east side that flow throughout the year. Seepage from hydrostatic pressure of the Mississippi River also contributes when the river is high. The external source is, of course, the Mississippi River which can be let into the unit when its level is higher than the level of the interior waters. As stated before this seldom happens at the time of year desired.

## 2. MANIPULATION

### TABLE OF WATER ACREAGES

#### KEITHSBURG POOL

<u>Elevation</u>	<u>Area (Acres)</u>	<u>Capacity (Acre-Feet)</u>
532.0	715	1,547
530.0	284	649
529.5	178	534

Average Depth Assumed: 3.0 feet at 529.5.

With our present facilities our annual water program will be generally as follows: During the period January through May the area should be held as low as possible to accommodate melt water, spring rains, and seepage from both the river and the east bluff. On June 1st, the level should be 529.00, and the pool should be held as close as possible to this until at least August 15th. This summer level facilitates

farming operations and considerable invasion of exposed mud flats by waterfowl food plants.

After August 15th the pool should be allowed to raise steadily through runoff, seep, or using the river proper so as to reach the 530.50 level by September 15th. Caution should be taken to insure that the level does not rise too quickly and flood the cropland. This level will be held until October 1st to facilitate harvest of crops. The pool will again be allowed to raise to the 532.00 level by the end of November. After December 1st the level should be raised as high as possible either as a result of precipitation or with the water backed in from the river. On or about December 15th, after the majority of the waterfowl have left the area, the water level should be lowered as much as possible.

One problem arising from the above program is the complaints from sport fishermen that summer water levels in the area are too low. To offset these complaints and also to improve the area for waterfowl a rough fish eradication program should be initiated. The removal of rough fish would improve sport fishing tremendously even with our summer drawdown. It would also improve growth of submergent vegetation on the unit as at the present time it is almost non-existent.

If after several years of this type of water management there is no appreciable increase in waterfowl use days, and no possibility of providing a reversible water pump on the area, we suggest that the following alternate program be followed as an experiment:

Under the present program the water level reaches its peak in December and then following the departure of the waterfowl it is lowered. We suggest that instead of lowering the water level that it continue to be raised throughout the year, taking advantage of spring and fall floods. The intent of this program is to flood the area to a level of approximately 535.00. It could be held at this level for several years depending upon the objective. It could be done for one or two years as merely an experiment to see if waterfowl useage increases. Or it could be used as a management tool to kill out all upland growth prior to master development to facilitate land clearing, dike building, and etc.

### 3. RECOMMENDATIONS

#### a. ANNUAL WATER PROGRAM

It is recommended that future annual water management programs

follow substantially what we have outlined above. If more specific recommendations are needed they can be made at the time the Refuge Manager submits his annual program. If it is determined that no water pump will be available for the next ten years, then the flooding program should be seriously considered to attempt to increase waterfowl useage.

b. DEVELOPMENT

The purpose of further development on the Keithsburg Unit is, of course, to take advantage of the wonderful potential the area has as a waterfowl area. A secondary purpose is to complete the development that has already been accomplished and to receive benefit from the \$90,000 the Bureau has already invested.

Proposed development calls for a cross dike and a pumping station to achieve maximum control of water on the area. As outlined on the attached map (Exhibit 2) one and one-fourth miles of road-dike would be required along with the installation of at least a 30,000 G.P.M. reversible pump, preferrably electric. These facilities would allow maximum control of the entire area.

It would provide two separate pools. One (Pool 1) to be drawn down completely in the summer and planted to its maximum with moist soil crops. The other (Pool 2) would be drawn down as desired and allowed to be invaded by emergent waterfowl food plants, or it could be flooded throughout the year. Several types of management programs would be attainable. Below are the acreages of the proposed pool areas.

PROPOSED POOL ACREAGES

<u>Elevation</u>	<u>POOL 1</u>		<u>POOL 2</u>	
	<u>Surface Acres</u>	<u>Acre Feet</u>	<u>Surface Acres</u>	<u>Acre Feet</u>
532.0	153	302	560	1,245
530.0	46	102	238	547
529.5	28	84	150	450

Average Depth Assumed: 3.0 feet at 529.5.

C. GARDNER UNIT

1. DESCRIPTION

The Gardner Unit is composed of four typical Mississippi River islands, several small towheads and sandbars. The four large islands are; Long Island, La Grange Island, Flannigan Island and Shandrew Island. Together with the water area between them, they total 4,831 acres. Total water acreage on the unit totals approximately 596 acres which includes lakes, ponds and chutes administered as part of the refuge.

The unit is unprotected from the river and it is not unusual for it to be completely inundated during the spring floods. All of the water areas of the unit with the exception of Duck Lake and some small ponds are connected to the Mississippi River and fluctuate accordingly to the whims of nature and the navigation needs of the U. S. Corps of Engineers.

The Duck Lake dike and pump and several small ponds have been the only water development projects attempted on the Gardner Unit. Duck Lake is a 5 to 7 acre slough that has been diked off from the river. It has a 24 inch outlet tube with gate attached. An 8 inch pump with Wisconsin engine has been utilized to pump water out of Duck Lake for drawdown purposes.

Two gauges have been established on the unit. A river gauge at the equipment building with a 00.0 of 460.00 and a pool gauge in Duck Lake with a 00.0 of 470.00.

2. MANIPULATION

TABLE OF WATER ACREAGES

<u>DUCK LAKE</u>		
<u>Elevation</u>	<u>Area (Acres)</u>	<u>Capacity (Acre-Feet)</u>
471.00	7.5	18.75
470.50	6.5	13.00
470.00	6.0	9.00
469.00	5.0	2.50

Average Depth Assumed: 1½ feet at 470. (All data estimated.)

OTHER UNIT WATERS

<u>Elevation</u>	<u>Area (Acres)</u>	<u>Capacity (Acre-Feet)</u>
472	700	4,900
471	650	3,900
470	590	2,950
469	500	2,000

Average Depth Assumed: 5 feet at 470.00. (All data estimated.)

The objective of managing the water levels on Duck Lake have been for the past two years to maintain a suitable water level for wood duck banding. Until the need of wood duck banding information diminishes we recommend that this objective remain the same.

By reversing the pump, as we are now doing, we will be able to continue our duck banding program, flood at least two acres of natural emergents and in addition flood a small portion of cropland. Following is the suggested program for accomplishment.

Following the spring rise, the Duck Lake control gate should be opened and the level allowed to seek an elevation of approximately 470.5, when this elevation is reached the gate should be closed. Either by pumping or letting in river water this elevation should be maintained throughout the summer until about October 25th. At that time the pump should be started and the water brought to a level of 471.5 as quickly as possible. When this level has been reached then the pump can be utilized to flood the adjacent cropland area throughout November. Following the fall migration period the Duck Lake level should be returned to the 470.00 mark.

If banding is not to be done on Duck Lake, then the level should be brought as low as possible early in the summer. By normal evaporation the level should be about 469.5 by the end of July. This should be maintained and kept lower if possible until late October. At that time pumping can be resumed and the level brought to 471.5 or higher. This should flood approximately eight acres of natural emergents.

No control can be carried out on the other unit waters as they are connected directly to the Mississippi River.

### 3. RECOMMENDATIONS

#### a. ANNUAL WATER PROGRAM

It is recommended that future annual water management programs follow substantially what we have outlined above. If more specific recommendations are needed they can be made at the time the Refuge Manager submits his annual program.

#### b. DEVELOPMENT

Since the Gardner Unit is an island with access rather difficult and the area is highly susceptible to flooding, little development is proposed. One short dike, similar to the Duck Lake Dike is proposed for Long Island Lake (Exhibit 3). This dike will be approximately 200 feet long. A pump capable of pumping out this 150 acre area in 7 to 10 days is also recommended at this location. This will allow the control of the major water area on the unit. A simple water control structure at the mouth of Upper Long Island Lake would provide further control. Normal management of this area would be to drawdown and allow natural emergents to invade or the area could be seeded with millet or some other appropriate moist soil waterfowl food.

### D. DELAIR UNIT

#### 1. DESCRIPTION

The Delair Unit lands lie entirely within the Sny Island Levee and Drainage District. The Sny Island Levee and Drainage District was established in the year 1880 under the laws of the State of Illinois by an act in force May 29, 1879. The district includes all the lands in an area which is about 50 miles long and three to seven miles wide situated between the main levee on the east bank of the Mississippi River and the bluffs on the east side of the valley. The law provided, among other things, for assessment of benefits and damages for each 40-acre tract of 110,000 acres located within the district, plus any additional acreage which subsequently may be found to be benefited and for the operation and maintenance of the facilities within the district such as pumping plants, levees, and channels.

Since organization of the levee district, a Mississippi levee was constructed and maintained on the east bank of the Mississippi River

for 52 miles. The levee commenced in the southeast corner of the northeast quarter of the southwest quarter, section 14, township 3 south, range 8 west in Adams County, Illinois. It extends along the west boundary of the district through Adams and Calhoun Counties for a distance of 52 miles to a point near the northwest corner of the southwest quarter of the northwest quarter of Section 4, township 9 south, range 3 west in Calhoun County.

In the year 1880 a strip of land 200 feet in width along the line of the levee was condemned in court proceedings for rights-of-way and damages were allowed and paid therefore, and the strip of land was taken by the Drainage Commission. The center line of the 200 foot wide strip is the center line of the levee. The Sny River, formerly was a natural channel of the Mississippi River and was as a navigation channel prior to the construction of the Mississippi Levee. It was declared by law to be a navigable stream and is over 60 miles in length. From a point near Sand Slough to a point in Calhoun County, opposite Clarksville, the Sny is looked upon as the main drainage canal for the adjoining lands and has been for more than 65 years since it was cut off from the Mississippi River at the head end.

The unit itself, lies in the Mississippi River bottoms at mileage marker 280. This area, protected from the Mississippi River by levee, is 1,738 acres of cropland, marsh, and water. The area is bounded on the north by the Gulf, Mobile and Ohio Railroad, on the west by the Mississippi River and the Pike Station State Refuge, on the east by the Sny River, and on the south by a private hunting club.

During a normal growing season between 900 and 1,000 acres can be farmed. About 400 acres of this is wet, low land that provides excellent opportunity for production of moist soil crops. Seep water from the Mississippi River is thought to be sufficient to flood these low areas in the fall.

The land surface elevation within the levees raises from 439 to 448 m.s.l. and includes several permanent water areas: Upper Swan Lake ---50 acres, Lower Swan Lake---65 acres, Butcher Pond---122 acres, Flake Hole---15 acres, and 15 acres of scattered ponds in farm fields. All of these, except the five scattered ponds, are connected by a drainage system to a central outlet to the Sny Island Drainage District System.

The development and management of this unit is complicated by the ground water conditions. The normal pool elevation above Lock and Dam No. 24 is 449 m.s.l. This is one to ten feet higher than the

refuge lands within the levees. Continued seepage occurs into this low area and ditches and the ground water table is never more than a few inches below the ground surface. This situation can now be controlled with the new flood control project keeping the Sny River at elevation 435 to 437 m.s.l. The area should drain by gravity flow into the Sny River.

The water in this area derives from two sources: precipitation and seepage from the Mississippi River pool above Lock and Dam No. 24. The former owner had installed a low lift pump with a capacity of 35,000 G.P.M. to enable him to farm part of the area. This pump discharged into Butcher Pond. The water level in Butcher Pond is controlled by a 48 inch and a 36 inch diameter culvert with flap gates through the levee into the Sny River.

The U. S. Corps of Engineers estimates the seepage into the Sny River along the stretch bordering the proposed refuge to vary from 10 to 100 C.F.S. This could increase slightly when the water levels in the Sny are lowered after completion of the flood control project. Only a very small part of this seepage appears within the refuge. The former owner ran the pump about one day a week to keep water levels low enough for farming.

At the present time there are no controls for retaining any water on the land now optioned. All water areas will eventually seek the level of the Sny River through gravity flow. This should be 435 to 437 as planned by the Sny Island Drainage District.

The following table gives the elevations of the main features influencing the management water in the unit.

a. Mississippi River Main Levee --	Top	459.0
b. Pool above Lock and Dam No. 24--	Normal	449.0
	Flood	457.0 +
c. Sny River Levee	Top	447.0 +
d. Water levels in Sny River	Present Conditions	
	Max. Flood	447.0
	Normal	440-444
e. Water levels in Sny River after construction of Corps of Engineers's flood control project.		
	Maximum	442.0
	Normal	435-437
f. Ground Surface inside levees		439-448
g. Flowline of drainage ditch at <u>pump</u> (Est.)		435
h. Elevation of bottom of Sny River Present		433-436
	After Cleanout	432



2. MANIPULATION

TABLE OF WATER ACREAGES

<u>SWAN LAKE</u>		
<u>Elevation</u>	<u>Area (Acres)</u>	<u>Capacity (Acre-Feet)</u>
440	115	575
437	90	180

Average Depth Assumed: 5 feet at 440.00

<u>BUTCHER POND</u>		
<u>Elevation</u>	<u>Area (Acres)</u>	<u>Capacity (Acre-Feet)</u>
440	122	427.0
437	22	11.0

Average Depth Assumed: 6 inches at 437.00

Because there are no controls located on the Bureau owned lands on the Delair Unit there is little that can be done regarding water manipulation. With the operation of the Sny Island Drainage District all waters within the unit are expected to seek the same level as the Sny River which should be 435 to 437. This should nearly dewater Butcher Pond and will lower Swan Lake considerably. Both areas should support good growths of emergent aquatics such as millets, smartweeds, rice cut grass, etc. This low water condition will continue throughout the year unless the outlet tubes are blocked. We suggest that in lieu of water control structures this be done by inserting pieces of plywood in front of the outlet tubes. This should be done about October 15th. Through natural seepage the level could be brought up gradually. In the lower and middle Butcher Pond Areas, this could be done very easily without the agreement of adjacent land owners. The Swan Lake Area would require the agreement of Mr. Paul Bakewell III as his ownership is included in the interior water system of which Swan Lake is a part.

It is recommended therefore, that the outlet tubes to the Sny River be blocked starting October 15th. The inlet tube leading from Swan

Lake into Butcher Pond should also be blocked to prevent water from backing into Swan Lake. The level in lower and middle Butcher Pond should not be allowed to reach higher than 438.5 unless agreement has been reached with the adjacent land owners. If agreement has been reached with them for raising the water of the interior area and Upper Butcher Pond then water could be allowed to back into Swan Lake and Upper Butcher Pond and over onto the low moist soil crop-land areas to a level of 440 or higher. Mr. Bakewell's objective is primarily waterfowl hunting so he should be agreeable to making conditions better for waterfowl on both his area and the refuge. Following the close of the waterfowl season the water should be lowered to 435 to 437, the normal level of the Sny River.

### 3. RECOMMENDATIONS

#### a. ANNUAL WATER PROGRAMS

Unless through experience we find that the suggested water program is not practical, we recommend that the annual water management program follow substantially what we have outlined above until controls have been constructed. If changes are needed or more specific recommendations are needed they can be made at the time the Refuge Manager submits his annual program.

#### b. DEVELOPMENT

The proposed development of the area has been prepared by the Branch of Engineering in a Preliminary Engineering Report for the area. This report calls for a major inlet structure entering the unit from Pool 24, inlet ditching, and eleven smaller slide gate structures.

The entire system will operate on a gravity flow basis. Water can be brought into the unit at anytime from the main river which at normal pool is from one to ten feet higher than the ground surface of the unit. With the system of ditches and minor control structures this water can be distributed throughout the area (Exhibit 4). Drawdown of the water can be through the outlet pipes into the Sny River which will be maintained by the Drainage District at 435 to 437. This system will give the unit optimum control at anytime of the year except during major flooding periods.

The Sny Island Levee and Drainage District will be petitioned for pumping water from, or discharging water into, the Sny Drainage system and for impoundment of water between the Sny River Levee and the old bank. Approval of the district which will permit construction and operation of the structures necessary for managing the water levels within the refuge area, should be obtained without difficulty.

E. ANNADA UNIT

1. DESCRIPTION

The Annada Unit, in Pike County, Missouri, lies in the Mississippi River bottoms at mileage marker 261. The area is bounded on the east by the Mississippi River Levee, on the north by the Ramsey Creek Levee, on the south by the Bryants Creek Levee, and on the west by the C. B. and Q. Railroad. It lies within the Elsberry Drainage District which is currently active.

The area is approximately <sup>3700</sup>~~6,000~~ acres of cropland and timber of which 98% is cropland. It has an extensive ditching system to remove surface and seep water to permit farming. This ditching system is connected to a single outlet which runs under Bryants Creek into the Elsberry Drainage District. Nothing is known about the effect Federal acquisition will have on the present status of this district. The Elsberry Drainage District contains approximately 23,500 acres.

The area soils are river silt and tend to be quite clayey. A soil boring investigation has been conducted in this area by the U. S. Corps of Engineers as part of their main levee study. Soils are generally quite impervious and are a satisfactory source for dike embankment material.

Water in this area derives from two sources, direct precipitation and seepage through the levee. The present owners have attempted to remove excess water by gravity flow, but have achieved little success.

2. MANIPULATION

At the present time no manipulation is possible on the unit except for one, approximately fifteen acre development, constructed under the Department of Agriculture's Recreation Program. This is a small

impounded area that has been flooded in the past with a shallow well, irrigation pump which is no longer available. Until a pump can be purchased to fill this area no water control can be carried out. After purchase of a suitable pump, management will consist of dewatering early in the spring, planting the area to millet, then flooding in the fall. However, at the present time no water control is possible on the entire area.

### 3. RECOMMENDATIONS

#### a. ANNUAL WATER PROGRAM

Until some water control is achieved the annual water program will be negative. When some control is possible this plan will be revised and then specific recommendations can be made by the Refuge Manager at the time he submits his annual program.

#### b. DEVELOPMENT

Development of the area depends entirely on the effect Federal acquisition has on the drainage district. Since one of the primary political purposes of establishing the unit as a wildlife refuge was to divorce it from the district so as to make the remaining portion of the district feasible for development as a Flood Control Project. We doubt very much if the unit can depend upon the Drainage District to continue pumping water from the area. If this is the case then the Bureau will be required to construct a major pumping plant at the site of the present sluice box. This pump should be a reversible pump capable of at least 60,000 G.P.M. as it will be needed to dewater the entire area in the spring and flood the low portions in the fall. A series of smaller pumps could also be utilized for pumping into smaller field flooding areas.

If the drainage district does agree to continue the pumping as they are presently doing, then development will be carried out as outlined in the Branch of Engineering's Preliminary Engineering Report. This consists of the construction of one, 220 acres impoundment in the southeast portion of the unit (Exhibit 5). A 10,000 G.P.M. pump will be required to dewater and flood as desired. Source of water supply would be Bryants Creek.

No elevations

Two minor developments would also be desired on the northeast portion of the unit. One would be a 160 acre impoundment, covered mainly with pin oak. Two short dikes would be needed to tie in with the existing facilities and an 8,000 G.P.M. would be needed for flooding and dewatering. The other development would be the restoration of the area known as the Old Goose Pond. A small retaining dike would be required and a sand point pump for flooding purposes. A portion of the area would be maintained permanently as a decoy goose flock area. The remaining portion could be dewatered, planted to a moist soil crop and flooded in the fall.

A small pump would also be needed for the twenty acre area already present on the unit.

F. BATCHTOWN UNIT

1. DESCRIPTION

The Batchtown Unit, in Calhoun County, Illinois, borders the Mississippi twelve air miles from its union with the Illinois River, its midpoint being located at mileage marker 247. The unit is composed of timbered islands, narrow sloughs and small agricultural areas.

It is bordered by the main channel of the Mississippi River and is subject to annual flooding. The unit ground surface elevations vary from 430 m.s.l. to 437 m.s.l., nearly all of which is flooded by annual spring floods.

For water management purposes the unit is separated into three areas. The up stream area is actually in the river and consists of low wooded islands, sloughs, and small river channels. Depths for these water areas are highly variable and completely unknown. At full pool this area is considered to have about 417 acres of water surface. The middle area was partially diked off from the river last year. This area, the majority of which is believed to be less than two feet deep, contains a water surface of about 547 acres. South of this area, and cut off from it by the entrance road dike, is the lower area of completely uncontrolled water. In this area south of the entrance road there are approximately 103 acres of water. Again, actual depths are unknown, but most of this area appears to be less than three feet deep.

The upper and lower areas within the unit have no means of water control and management is impossible at this time. The middle pool encompasses what were once Prairie Pond, Black Lake, Watson Lake and Metz Lake. It is now one body of water located on the mainland approximately

in the middle of the unit. It is diked off from the Mississippi River. A reversible pumping station, permitting inflow or outflow at the rate of 20,000 G.P.M. has been completed.

Water sources for this middle area are surface run off from the adjacent uplands, seepage from the main river, and of course, the waters of the river itself.

Two water gauges have been established, both at the site of the pumping structure. The river gauge has a 00.0 reading of 426.11 and the pool gauge has an 00.0 reading of 430.0.

## 2. MANIPULATION

TABLE OF WATER ACREAGES

### UPPER POOL

<u>Elevation</u>	<u>Area (Acres)</u>	<u>Capacity (Acre-Feet)</u>
434	417	1,668
432	266	532
Average Depth Assumed: 4 feet at 434 (All data estimated)		

### MIDDLE POOL

<u>Elevation</u>	<u>Area (Acres)</u>	<u>Capacity (Acre-Feet)</u>
434	547	1,368
432	75	150
Average Depth Assumed: 2.5 feet at 434 (All data estimated)		

### LOWER POOL

<u>Elevation</u>	<u>Area (Acres)</u>	<u>Capacity (Acre-Feet)</u>
434	103	258
432	14	7.0
Average Depth Assumed: 2.5 feet at 434 (All data estimated)		

Since water levels of the upper and lower pools are controlled by the U. S. Corps of Engineers whose operations are geared to navigation needs, manipulations of these areas shall not be considered until some Bureau control is possible.

Management of the middle pool will consider only the primary objective number one, that of providing food, water and protection to migrating waterfowl. All other considerations must be secondary. To achieve this objective the following procedures should be followed:

Following the close of the waterfowl season the pool should be drawn down as low as possible to facilitate winter brush control. Encroachment by willows (Salix-exigua and S. interior) is almost assured. Some buttonbush (Cephalanthus occidentalis) is also present and some spreading of this species is expected. By a complete winter drawdown some control by rotary mowing and bulldozing could be accomplished. This should be followed up in the spring by aerial spraying new growth.

Unless affected by spring floods the pool should be brought to a level of 434.00 in early April and maintained until May 15th. If high water occurs in the spring this level should be achieved as soon after high water as possible. A 434.00 level will prevent early invasion of mud flats by willow and buttonbush and allow some use by migrating waterfowl.

On May 15th, we should begin to lower the pool so as to reach a level of 432.50 by the end of June. This will facilitate farming operations and allow some invasion of the mud flats by emergents. This drawdown should be done by gravity flow or pumping. If the U. S. Corps of Engineers have drawn Pool 25 down at an earlier date, then the middle pool can be drawn down by gravity flow at the same time to save pumping costs. However, if invasion of willow is excessive and control of it exceeds pumping costs then water levels of 432.50 must be reached by pumping the area down gradually. This gradual drawdown should continue as to reach a level of 431.0 or lower on July 15th. This level should be maintained throughout the summer by pumping one day out of each week.

A level of 431.0 will allow the permittee farmers to plant the margins of the wetland areas to moist soil crops as the refuge share. It will also expose approximately 475 to 500 acres of mud flat which should support a good growth of natural food. There should be enough residual seed of both smartweed and millet to allow considerable growth. Although these species will reach maturity by September, we do not recommend that any water be brought up on them until after September 1st. Starting on that date only normal seepage will be allowed. We do not recommend any

higher levels to avoid early utilization by waterfowl before the hunting season. The upper and lower pools will provide all that is necessary for early migrants. It is our recommendations that the middle pool be allowed to raise after September 1st by seepage alone. This can be continued until October 15th. At that time pumping will begin and by November 15th an elevation of 434 or higher should be reached.

This level will allow waterfowl utilization of the entire pool. If a higher elevation can be reached (434 to 435) then some cropland can be flooded so as to make even more waterfowl food accessible. This level should be maintained by pumping until the close of the waterfowl season. Caution must be taken when levels reach 435.00 to avoid high water tables on adjacent croplands before harvest is completed.

### 3. RECOMMENDATIONS

#### a. ANNUAL WATER PROGRAM

We recommend that management of the middle pool follow what we have broadly outlined above. More specific recommendations can be made at the time the Refuge Manager submits his annual program.

#### b. DEVELOPMENT

The main objective of development on the Batchtown Unit is to take advantage of the opportunity that is offered by the existing natural conditions and also to bring the unit to a standard that is comparable to the highly developed private duck hunting clubs in the immediate area.

At the present time the proposed water development is tied in with the recreational plans for the unit. The area referred to as the lower unit is a 103 acre area that is separated from the main river by several small chutes that can be easily blocked off by earth plugs. It is our recommendation that this be done in conjunction with the construction of the two-way public access road that is proposed along the south boundary of the unit. This road would then serve as a road-dike for this 103 acre water area. (Exhibit 6) With the construction of a simple slide gate structure the area could be manipulated similiar to the middle pool. It could be drawn down with gravity flow or pumped down with the middle pool.



It could be filled by gravity flow from the river or gravity flow from the middle pool. If through experimenting a simple slide gate structure is not sufficient a small pump could be installed. An additional control would also be needed between the middle and lower pools.

No other development is being proposed as the upper pool area should be maintained as an example of typical undeveloped river bottom habitat. It can be utilized as a wood duck brood rearing area. However, if commercialization of the river for recreation and navigation eliminates much of the existing natural habitat outside the refuge, then development would be necessary to allow maximum brood use in an effort to replace brood rearing areas lost.

#### G. CALHOUN UNIT

##### 1. DESCRIPTION

The Calhoun Unit, in Calhoun and Jersey Counties, Illinois lies along the Illinois River with mileage marker number seven at its midpoint. It begins five miles north of the confluence of the Illinois and the Mississippi Rivers at Grafton, Illinois. Most of the unit borders the Illinois River on the southwest side, but a small part lies on the opposite or northeast shore. Prior to the construction of the locks and dams in 1938, there was only a small portion of the unit under water. After the construction of Lock and Dam No. 26, a large portion of the area was covered by water which consequently flooded and killed the timber within the first six years. The large shallow lake that was formed is now called Swan Lake.

Swan Lake is directly connected to the river by a man-made cut opposite Six Mile Island and also at its lower end. This lower connection with the river is approximately one-half mile wide and variable in depth from a few inches to about five feet. Because of these connections no water control is possible. The lake is shallow, less than five feet deep for the most part, and much of it is less than three feet deep. Shore lines are very flat, with depth increasing quite gradually.

The lake, being wide and long, reacts to winds rather violently. A persistent wind of any force, from almost any direction, will result in heavy wave action along the windward shore. This wave action through the years has apparently been responsible for the absence of marsh vegetation along the flat shore lines. Narrow fringes of cattail (Typha Latifolia) and river bulrush (Scirpus Fluvialis) are present

along shore lines in some places but for the greatest part buttonbush (Cephalanthus occidentalis) and grasses extend lakeward to a small bank (8 to 12 inches high) which drops directly into the water. Comparatively stable water levels have permitted extensive stands of lotus (Nelumbo-lutea) to develop in waters 8 to 20 inches deep. These lotus beds are heavily used by wood duck as loafing and rearing habitat. Submergents were present in quantity over at least half of the lake in 1963. The most obvious was American pondweed (Potamogeton nodosus). Also present were sago (P. pectinatus) and naiad (Najas sp.). Production of these submergents was excellent and their presence was largely responsible for waterfowl use on this lake during the fall of 1963. The chief deterrent to these plants seems to be high muddy waters. In 1963, with no flooding or excessively turbid water entering the lake, the waters remained clear and top notch production resulted.

The Gilbert Lake Area on the southwest side of the river is a long narrow lake of approximately 224 acres bordered by timber. This area is separated from the river by a low dike-road. It can be manipulated by an 8,000 G.P.M. <sup>pump</sup> located at the east end.

Gilbert Lake is characterized by wide flat shore lines. It has an area of 224 water surface acres at maximum size. It has an estimated capacity of 448 acre feet. During the months of February and March, 1963, approximately 50 acres of its shore line was cleared of willow (Salix sp.) and buttonbush. This clearing operation did not include any herbicidal treatment. Dense stands of willow sprouts have developed along these cleared areas and controls are badly needed. In 1963, when water levels receded, the west end of the lake produced a dense stand of water dock (Rumex verticillatus) which matured and seeded. Lotus beds developed along the shore lines at depths of about one foot and as the lake shallowed these were left standing on mud flats. Heavy seeding did take place. These lotus beds were used extensively by wood ducks for loafing and rearing areas. Brood use of these beds was excellent. Scattered stands of cattail (T. latifolia) and river bulrush (S. fluviatilis) were present in shallow areas. A heavy stand of rice cut grass (Leersia cryzoides) developed on the natural levee at the east end and in the cleared areas along the shore lines. This stand of grass was a boon to swamp sparrows, but little waterfowl use took place. Some smartweeds (Polygonum coccineum) and (P. lapathifolium) were present. Arrowhead (Sagittaria sp.) developed in a fairly narrow fringe along the shore lines where willow and rice cut grass were not too heavy. The outstanding vegetation on Gilbert Lake in 1963 was the submergent plants. Most noteworthy were the pondweeds, American, sago, and naiads. They were eaten by wood duck throughout the summer and accounted for most of the heavy duck use on this lake during the fall. Gadwall, American Widgeon, Mallard, Shoveller, Blue and Green-Winged Teal, as well as

coot were on this lake from the beginning of the migration until it froze solidly in December.

Elevations of the unit vary from 414 m.s.l. to approximately 428 m.s.l., nearly all of which can be inundated by spring floods. In the past a successful crop could only be expected once in four or five years, however more recently the areas have been fully cropped each year for the most part.

Water gauges on this unit are located on the Gilbert Lake structure. The pool gauges has a 00.0 of 400.00 m.s.l. and the river gauge has a 00.0 of 411.64 m.s.l.

Included in the Calhoun Unit is the Portage Islands Refuge. The small refuge, 226 acres, is a group of three islands in the Mississippi River near mileage marker 215 in St. Charles County, Missouri. The islands are completely covered with timber and brush. Some inland water areas are present but no cropland is available.

## 2. MANIPULATION

### TABLE OF WATER ACREAGES

#### SWAN LAKE

<u>Elevation</u>	<u>Area (Acres)</u>	<u>Capacity (Surface Acres)</u>
419.0	2,600	8,450
418.5	2,400	7,200
418.0	2,200	6,050

Average Depth Assumed: 3 feet at 418.50 (All data estimated)

#### GILBERT LAKE

<u>Elevation</u>	<u>Area (Acres)</u>	<u>Capacity (Surface Acres)</u>
418.5	224	336
418.0	150	150
417.0	0	0

Average Depth Assumed: 1.5 feet at 418.5 (All data estimated)

No manipulation of Swan Lake is possible since there are no controls present and all water management is subject to the whims of nature and navigation interests.

Because of the costly investment in water controls on Gilbert Lake, the area must be managed to get the maximum waterfowl useage. It was an original intention to manage it some years for wood duck banding only; however, in reviewing the investment it has been decided to look elsewhere for a banding site and manage the Gilbert Lake Area primarily for the production of waterfowl food for fall migrants.

With this objective in mind the following broad guidelines are recommended. Following the close of the waterfowl season the lake should be drawn down as low as possible to facilitate winter control of willow and button-bush which will undoubtedly invade the area. This winter drawdown will continue until high water in the spring. In event there is no high water then the level should be brought to elevation 418.5 to allow some useage by spring migrants. This level should continue until June 15th. If high water does occur then the 418.5 level should be obtained as soon after the high water recedes as possible.

On June 15th the lake should be drawn down gradually by pumping or gravity flow to elevation 417.00 which is the bottom of the outlet ditch. This should be reached by July 15th and maintained until October 15th. The level should then be brought up gradually until it peaks at 418.5 or higher by November 15th. This will require pumping with the electric pump. It is estimated that ten days of pumping will be required to reach the desired level. Caution should be taken to see that the level does not interfere with harvest operations on the adjacent croplands. This level should be maintained throughout the fall migration or until December 10th. It should then be quickly taken off prior to final freeze up for winter brush control work.

We do not, however, overrule managing the area specifically as a wood duck brood rearing area. If natural areas outside the refuge are eliminated then it must be considered. Changes can be made by an amendment to this plan.

### 3. RECOMMENDATIONS

#### a. ANNUAL WATER PROGRAM

We recommend that management of Gilbert Lake follow generally what we have outlined above. Changes and more specific recommendations can be made at the time the Refuge Manager submits his annual program.

b. DEVELOPMENT

No further development is contemplated at Gilbert Lake. A cross dike was considered, however, its cost and the additional benefits received do not justify its construction.

Swan Lake, however, presents a real challenge for water developments. It depends upon land acquisition, public approval, and cost benefit ratio consideration. As outlined below the development is separated into three phases. The first two will be included in the future program schedules and the third is mentioned as an alternate to the second.

PHASE I

This phase depends upon the proposed acquisition of lands at the lower end of Swan Lake. If these lands are acquired then the development of the wetlands located on them should be undertaken. As outlined on the attached map (Exhibit 7) we are proposing that four low wetland areas be connected to the Illinois River by a system of ditches (1.5 miles). Three small pumps would also be necessary. By dewatering these areas by pumping we would be able to plant approximately 105 acres of moist soil crops and then flood in the fall to make them available to waterfowl. They are ideally located as they are dispersed throughout several hundred acres of cropland.

PHASE II

This phase of development as outlined on the attached map harnesses a portion of Swan Lake. With the construction of .5 mile of closing dike at the upper end and .8 mile of closing dike at the lower end we would have control of approximately 1,632 acres of water. To insure proper dewatering and flooding a pump of at least 50,000 G.P.M. capacity would be necessary. This would be located at the outlet structure at the lower end of the impoundment. The total area could not be drawn down; however, with the proper management we could expose approximately 1,000 acres to invasion by natural emergents, millets and smartweeds.

We have one reservation regarding the above development. By closing off this portion of Swan Lake, we will be blocking off boat access to it from the Illinois River. Many fishermen consider Swan Lake

to be one of the finest fishing areas in the area and undoubtedly any move to close the area to fishing by blocking the access or through water management will not meet with public approval. Although it would be one of the finest waterfowl areas in the country we do not feel that the Bureau could withstand the pressure in view of some of the recent attitudes taken regarding conflicts with fishermen on our other areas. In lieu of a possible stalemate on this development we are proposing Phase III.

### PHASE III

As stated above this phase is offered in lieu of Phase II. It consists, as outlined on the attached map, of blocking off only a portion of Swan Lake rather than the entire south end of the Lake. Included in this proposal would be the construction of 2.3 miles of cross dike to block off two bays of the Lake. The lower bay, 225 acres, would require 1.2 miles of cross dike and one 8,000 G.P.M. pump. The upper bay, 175 acres, would require 1.1 mile of cross dike and a similiar pump. Management would be the same as the other areas on the refuge. The most important factor to consider here is the cost-benefit ratio. Development costs will be extremely expensive for the acreage involved. However, by the time this development is under consideration optimum waterfowl habitat may be so necessary it will be developed without considering cost.

No development is planned for the Portage Islands portion of the Calhoun Unit.

## III -- GENERAL INFORMATION

### A. WATER SUPPLY AND RIGHTS

We have mentioned water supply only briefly in the body of the plan. As in all cases on Mark Twain Refuge, water is readily available directly from the Mississippi River. In Missouri riparian doctrine prevails while in Illinois land ownership is the basis for water rights. In acquisition of lands, rights to the use of surface and groundwater including riparian rights should be obtained. In Illinois this involves obtaining approval of plans and securing a permit from the Illinois

Department of Public Works and Buildings, and the U. S. Corps of Engineers. Prior to construction on the Delair Unit we will have to secure court approval on a petition to the Sny Island Levee and Drainage District for discharging into and taking water from the local channel and levee system.

We are not aware of the situation in Iowa, but as it exists now we require approval of only the U. S. Corps of Engineers for construction and use as much water as necessary from the Mississippi River.

B. EASEMENTS

On the Keithsburg, Batchtown and Calhoun Units flooding easements should be taken from adjacent land owners to allow maximum control of water levels. On most of the areas no actual flooding of private lands will occur but ground water tables may be raised enough to affect farming operations. In all cases, however, acquisition of the same lands is recommended for other management purposes. Flooding easements would be necessary in lieu of actual acquisition.

On the Delair Unit some type of water agreement should be worked out with Mr. Bakewell and the other two land owners, until the Bureau has acquired the entire area.

C. BOTULISM AND ALGAL POISONING

We have no record of either botulism or algal poisoning on the refuge but then we have only had water management on one unit for any length of time. If either of the above do occur recommendations can be made at the time the Refuge Manager submits his annual report, for the corrections of these disasters.

D. FLOODS AND DROUGHTS

No drought will ever seriously affect water management on Mark Twain Refuge as the Mississippi and Illinois Rivers are held at fairly constant levels for navigation purposes and for the most part these rivers are our source of supply. At the present time only the Keithsburg Area depends upon fall rains and surface runoff for flooding in the fall.

Floods of course, are frequent and very severe, sometimes flooding the entire units. We are including little history of floods in this plan as good records are readily available if needed. For the most part there is little we can do about them except keep our management programs flexible enough to adjust when flooding does occur. We have included a graph (Exhibit 8) showing high water stages on the Gardner Unit which is located midway in the refuge and should be fairly representative.

E. PUBLIC RELATIONS AND RECREATIONAL ASPECTS

For the most part our summer drawdowns conflict directly with recreational use of the areas and at times considerable pressure comes to bear for changes. We see no alternative. If these areas are to be managed for waterfowl then they must be. In most cases there is no compromise. We feel that with all the recreational areas available along the Mississippi and Illinois Rivers we do not have to bow to recreational pressures. The areas must be managed with the primary objectives in view.

F. VEGETATION CONTROL

With the practice of summer drawdowns the invasion of willow, button-bush, and other undesirable species is almost assured. Winter drawdowns and control at that time by mowing and spraying as a follow-up in the spring will be the methods of control. On most of the units water levels cannot be raised high enough to permit killing these species by flooding. It can only be used to prevent further invasion; however, the drawdown must be accomplished early enough in the year to allow moist soil plants to mature. Control of undesirable vegetation will continue as an annual major program, there will be no easy method.

G. RECORDS

Now that water gauges have been established on all units, monthly gauge reading reports will be filed and submitted to the Regional Office for all impoundments.

Photo points have been established on all impoundments to record vegetative changes that occur from year to year. Photos will be taken twice a year, spring and fall. They will be filed in a permanent file at the refuge headquarters. Vegetative transects have



also been established on some of the units and these will be continued. Reviews of annual water programs will also be on file in refuge offices and submitted to the Regional Office for the records.

#### H. ROUGH FISH CONTROL

Control of fish is recommended only on the Keithsburg, Louisa and Delair Units where it is feasible and where electric weirs can be established. This will be outlined in the fish management plan. On the other areas it is generally not feasible, because of reinfestation from high water of the Mississippi and Illinois Rivers.

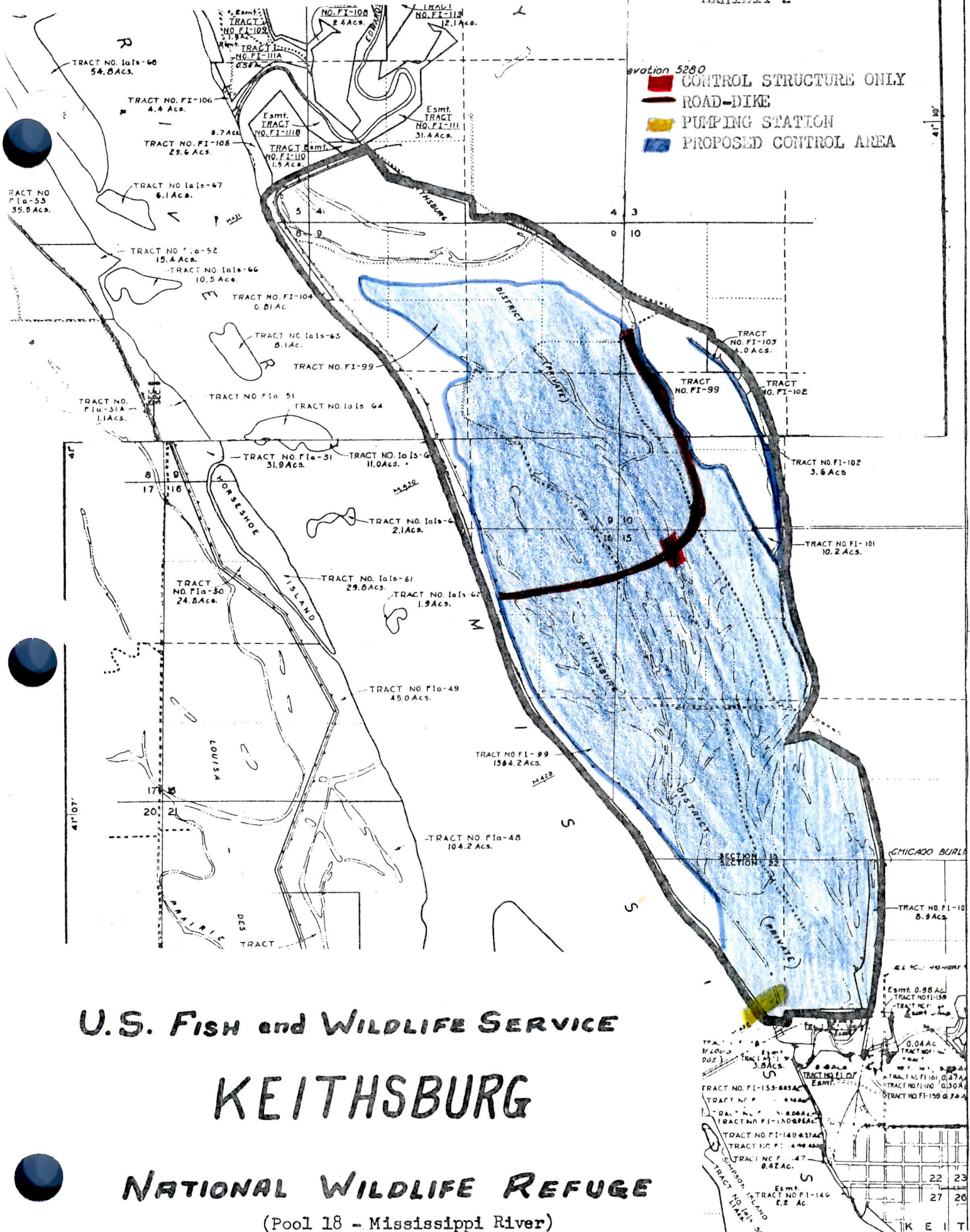
#### I. WILDLIFE RESPONSES

We have made recommendations for management and development with only the number one objective in view. Much of the refuge remains undeveloped and suitable as wood duck brood cover and habitat for other wildlife such as fur bearers. Muskrats, of course, will be affected materially by our summer drawdowns, however, no real damage to the population is anticipated. Most of the animals will migrate to more favorable habitat. If water management is needed for wood ducks, such recommendations can be made in the annual programs or by revising this plan.

Waterfowl response to water management in the past, is for the most part unrecorded. High waterfowl populations on Mark Twain Refuge depend upon many factors but water management remains the most important particularly in the Keithsburg, Louisa, Batchtown and Gilbert Lake Areas. The all time high population on the refuge occurred on the Batchtown Refuge in 1953 when over a million mallards used the refuge. This was contributed directly to the water management of the U. S. Corps of Engineers that year, a summer drawdown and a fall raise. This is the use that we are attempting to duplicate. Attached is a table showing waterfowl use on the existing units for the past eleven years (Exhibit 9). Note where waterfowl use on the Keithsburg Unit has actually dropped after repair of the \$90,000 levee suggesting a pump is needed or a drastic change in our management program.





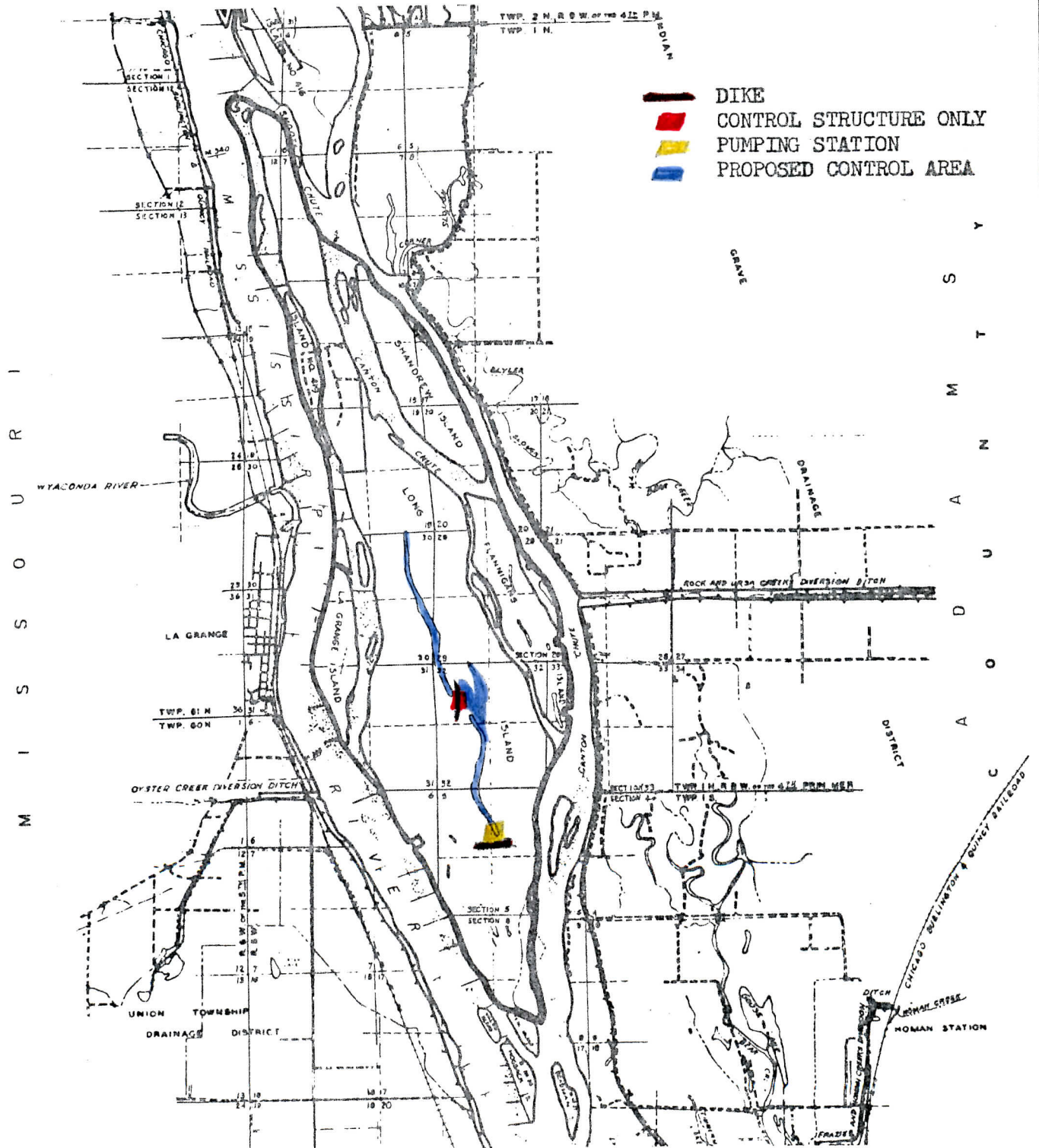


UNITED STATES DEPARTMENT OF THE INTERIOR  
BUREAU OF SPORT FISHERIES AND WILDLIFE

# MARK TWAIN NATIONAL WILDLIFE REFUGE GARDNER UNIT ADAMS COUNTY ILLINOIS

SCALE 1" = 6000'

POOL NO. 21





# MARK TWAIN NATIONAL WILDLIFE REFUGE (DELAIR UNIT)

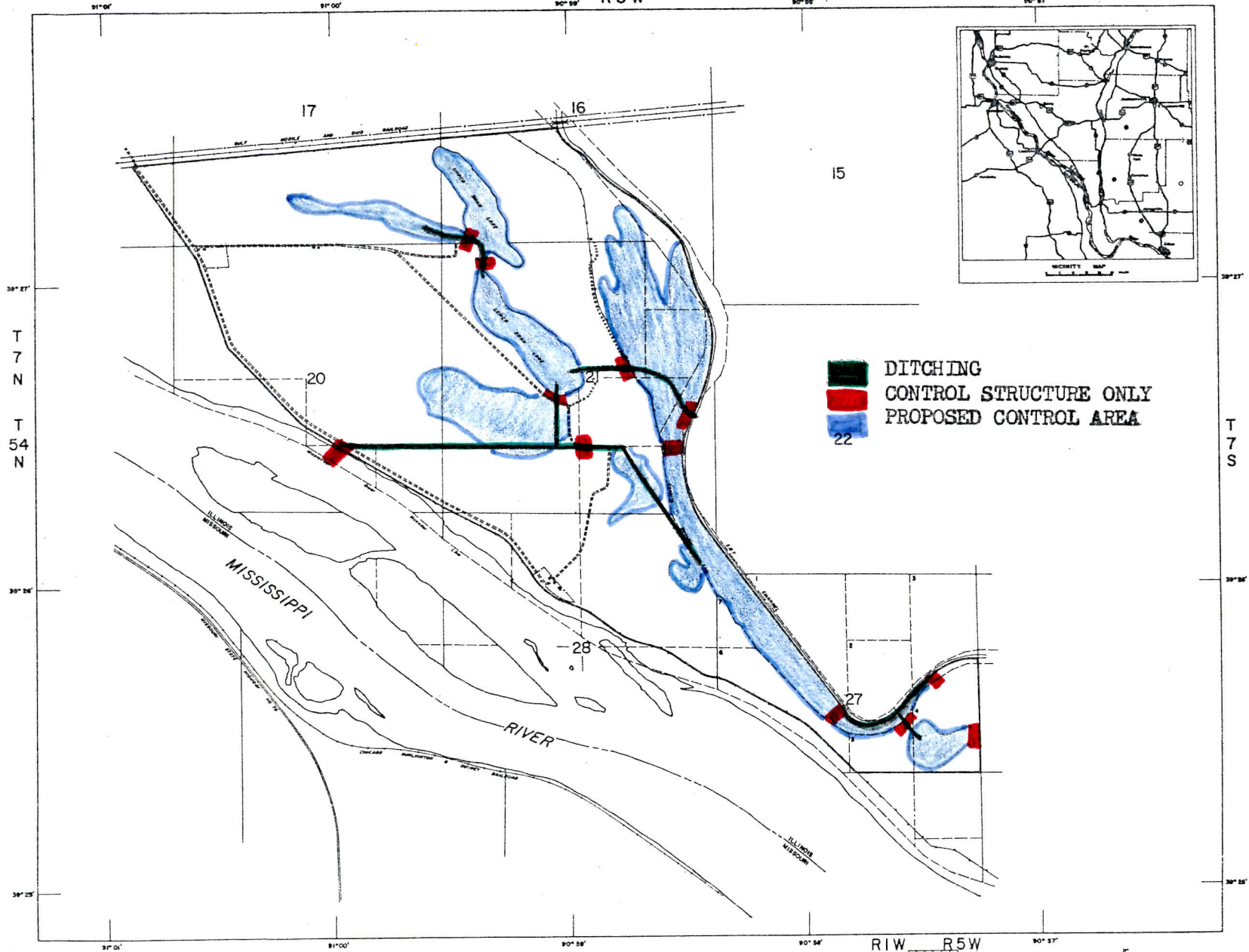
PIKE COUNTY, ILLINOIS

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UNITED STATES  
DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE SERVICE  
BUREAU OF SPORT FISHERIES AND WILDLIFE

EXHIBIT 4



COMPILED IN THE BRANCH OF ENGINEERING  
FROM AERIAL PHOTOGRAPHS AND SURVEYS  
BY THE B.L.M.

MINNEAPOLIS, MINNESOTA

JULY, 1961

FOURTH PRIME MERIDIAN

Scale 0 10 20 CHAINS  
0 1/8 1/4 1/2 MILE

R 1 W R 5 W

TOWNSHIP  
DIAGRAM

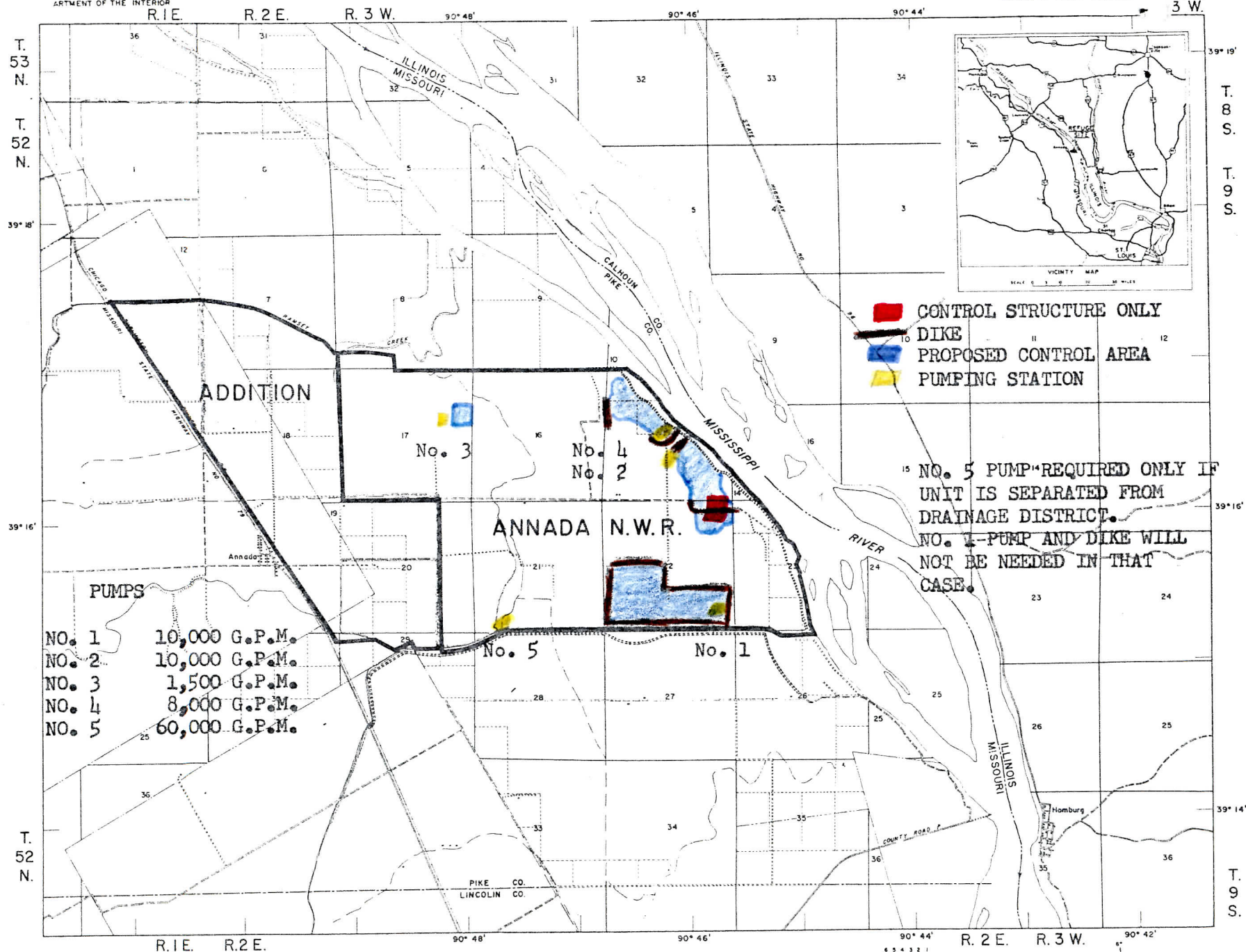
MEAN  
DECLINATION  
1960

# MARK TWAIN NATIONAL WILDLIFE REFUGE (ANNADA UNIT) PIKE COUNTY, MISSOURI

UNITED STATES  
DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE  
BUREAU OF SPORT FISHERIES

WILDLIFE  
3 W.

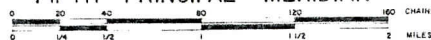


COMPILED IN THE BRANCH OF ENGINEERING  
FROM AERIAL PHOTOGRAPHS AND SURVEYS  
BY THE B.L.M.

MINNEAPOLIS, MINNESOTA

SEPTEMBER, 1963

FIFTH PRINCIPAL MERIDIAN



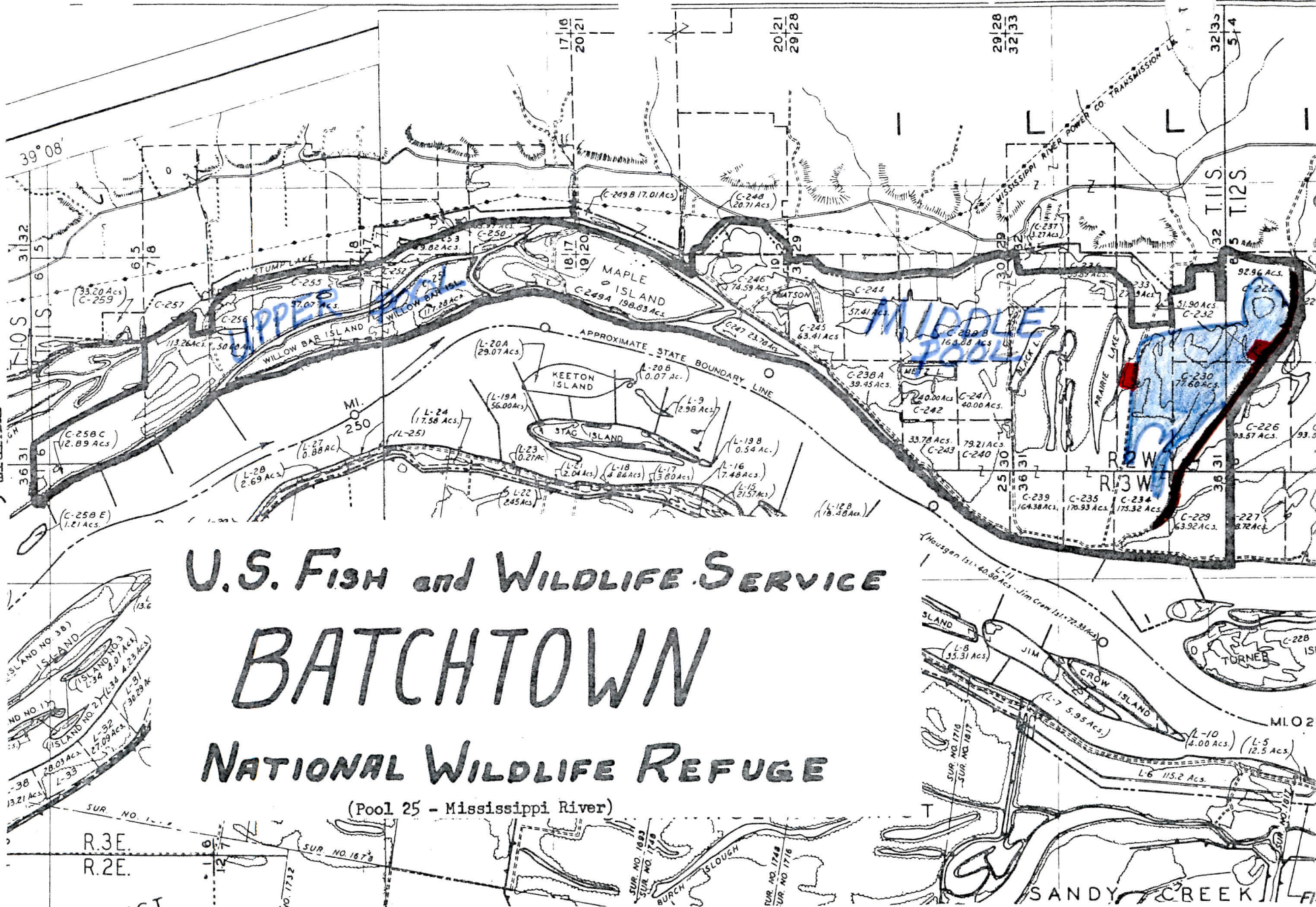
TOWNSHIP  
DIAGRAM

MEAN  
DECLINATION  
1960

EXHIBIT 5



EXHIBIT 6



ROAD DIKE



CONTROL STRUCTURE ONLY



PROPOSED CONTROL AREA

(Recreational Development)









# U.S. Fish and Wildlife Service

# CALHOUN

## NATIONAL WILDLIFE REFUGE

(Pool 26 - Mississippi River)

Flowage Project Boundary

-  ROAD DIKE
-  CONTROL STRUCTURE ONLY
-  DITCH
-  PUMPING STATIONS
-  PROPOSED CONTROL AREA
-  SWAN LAKE AT PRESENT (Uncontrolled)

Flowage Project Boundary

CALHOUN CO.

Phase III

Phase II

PERE MARQUETTE STATE PARK

Adjusted Maximum Regulated Pool

Adjusted Maximum Regulated Pool

Phase I

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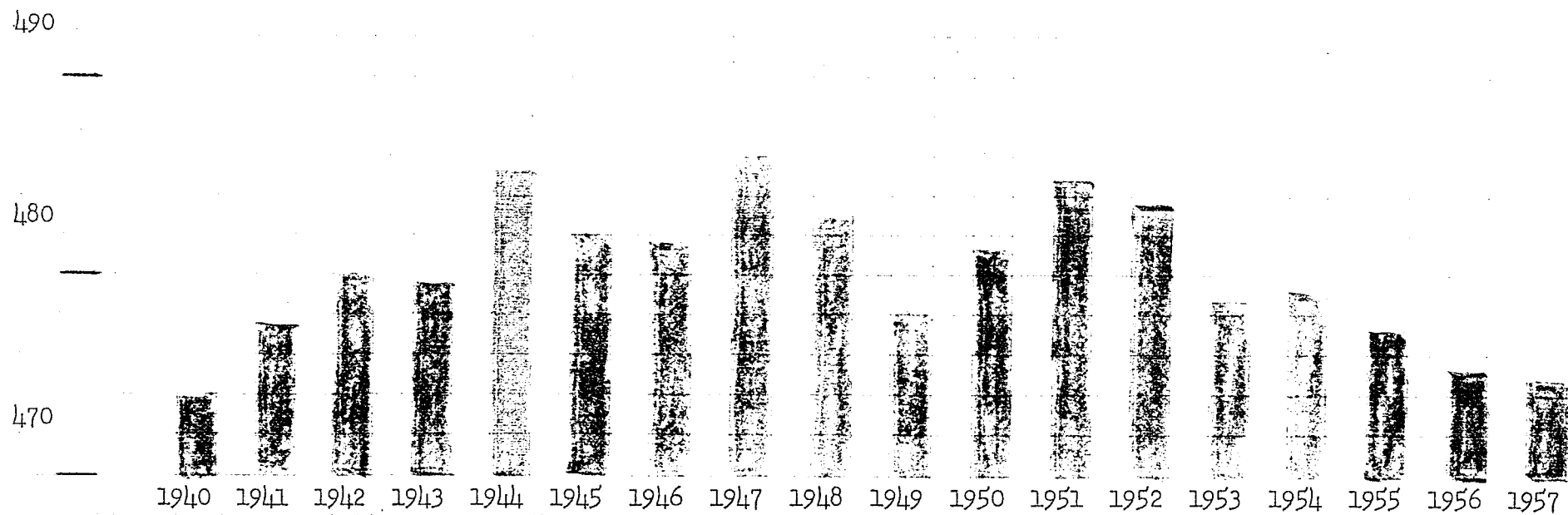
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# GARDNER UNIT HIGH WATER STAGES

1940 -- 1957



470 -- Normal Pool Elevation  
 484.5 -- Will Inundate Entire Unit

TOTAL DUCK DAYS USE -- FALL PERIOD  
MARK TWAIN REFUGE  
1953 -- 1963

YEAR	LOUISA REFUGE	KEITHSBURG REFUGE	GARDNER REFUGE	BATCHTOWN REFUGE	CALHOUN REFUGE	MARK TWAIN REFUGE
1953	--	--	--	20,907,500	8,813,035	38,720,535
1954	2,686,390	2,316,965	--	5,709,200	18,626,755	29,339,310
1955	3,261,440	4,179,210	--	2,130,695	21,504,875	31,076,220
1956	7,499,345	3,465,490	--	5,032,300	18,133,325	34,130,460
1957	10,783,150	3,193,750	--	1,766,625	5,424,300	21,167,825
1958	2,800,532	88,830*	240,471	1,698,830	15,208,235	20,036,898
1959	4,129,157	1,458,765	692,979	3,754,450	8,615,250	18,650,600
1960	2,391,872	2,064,657	730,821	2,979,760	5,913,740	14,080,850
1961	2,633,425	779,170	677,964	1,000,090	2,822,855	7,913,504
1962	1,790,334	469,805	691,598	2,446,640	2,783,683	8,182,060
1963	2,461,445	236,950	1,118,621	608,160	2,495,444	6,920,620
AVERAGE:	4,043,700	1,025,350	692,075	5,184,900	10,031,000	20,929,000
1963 Change From:						

Average	39.13% <del>-</del>	87.02% <del>-</del>	61.63% <del>+</del>	88.28% <del>-</del>	75.13% <del>-</del>	66.94% <del>-</del>
1962	37.48% <del>+</del>	49.57% <del>-</del>	61.74% <del>+</del>	75.15% <del>-</del>	10.36% <del>-</del>	15.41% <del>-</del>

\*Keithsburg Levees Out--No Water In 1958. Levee Repaired In 1960.

Delair and Annada Units Not Acquired Until Fall of 1964.

SIGNATURE PAGE

Submitted by:

E. S. Crozier  
(Signature)  
E. S. Crozier  
Refuge Manager  
Title

Date: October 1, 1964

Approved, Regional Office:

Date: \_\_\_\_\_

\_\_\_\_\_  
(Signature)

Regional Refuge Supervisor

Approved, Central Office:

Date: \_\_\_\_\_

\_\_\_\_\_  
(Signature)